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Axuial bifurcation and duplication in snakes. Part IV. First record of a dicephalic *Boa constrictor occidentalis* (Serpentes: Boidae)

Introduction.

Wallach (2007) provided a synopsis and overview of 950 reports of ophidian axial bifurcation, more commonly known as dicephalism as the majority of cases involve duplication of the head. Axial bifurcation is now known in at least 170 species, 95 genera, and eight families of snakes (Wallach, unpubl.).

In addition to a pair of unverified internet reports and several anecdotal reports of dicephalic *Boa constrictor* (Costa Rica *fide* Anonymous, 1974; Germany *fide* Jim Pether, pers. comm.), there have been five published cases (Cunha, 1968; Frye, 1981; Meister, 1988; Gaupp, 1990; Stöckl & Stöckl, 1996) and four unpublished cases (Anonymous, 2003, 2004, 2005; Wallach, unpubl.).

I here report on the tenth documented record of axial bifurcation in *Boa constrictor* and the first record for the subspecies *B. c. occidentalis* Philippi (1873). Recognized subspecies of *Boa constrictor* range from 6 to 10 (Stimpson, 1969; Peters & Orejas-Miranda, 1970; Vosjoli et al., 1998; Walls, 1998; McDiarmid et al., 1999; Bonny, 2007). Langhammer (1983) recognized nine subspecies and characterized *B. c. occidentalis* as having 65-87 midbody scale rows, 242-251 ventrals, 45 subcaudals, 22-30 irregular dorsal body blotches, black caudal blotches, and strong black ventral pigmentation. Walls (1998) recognized seven subspecies of *Boa constrictor* while considering *Boa nebulosus* and *Boa orophias* as full species instead of subspecies of *Boa constrictor.*

Materials and Methods.

Digital radiographs were taken with a Thermo Kevex X-ray machine (model PXS10) using a PaxScan 4030R system with ViVA software. Paired counts denoted as left/right. SVL = snout-vent length, LOA = total length.

Results.

The specimen is a captive born neonate *Boa constrictor occidentalis* whose parents originated from Argentina and were acquired from Eugene Bessette of Ophiological Services in Gainesville, Florida (Fig. 1). The parents were maintained and bred by Marc Seymour. Birth of either 24 or 25 young occurred in August 1995. Both heads fed and the snake shed one time before it died.

Snout-vent length 365 mm, tail length 44 mm, LOA 409 mm, relative tail length 10.8%; left head length 4.9 mm, maximum temporal width 4.4 mm, eye-snout interval 2.5 mm, right head length 5.9 mm, maximum temporal width 4.7 mm, eye-snout interval 3.0 mm; scale rows on left neck 57, right neck 63, midbody scale rows 84, and cloacal scale rows 46; ventrals on left neck 24 (with 2 preventrals and 8 half-ventrals), right neck 22 (with 3 preventrals and 6 half-ventrals), fusion zone ventrals 12 (at which point 8 ventrals extend perpendicularly up left side of body, remaining trunk ventrals 189, maximum ventrals 225, anal single, subcaudals 42; spurs obvious, 1 mm in length; left head supralabials (21/20), infralabials (24/22), circumorbitals (16/16), interoculars (14); right head supralabials (19/20), infralabials (24/24), circumorbitals (16/18), interoculars (15); nasal entire.

Dorsum gray with 18 dark gray irregular dorsal body blotches plus 3 rectangles each on left and right necks; tail maroon with 3 cream cross-bars and a ventrolateral cream stripe; ventral

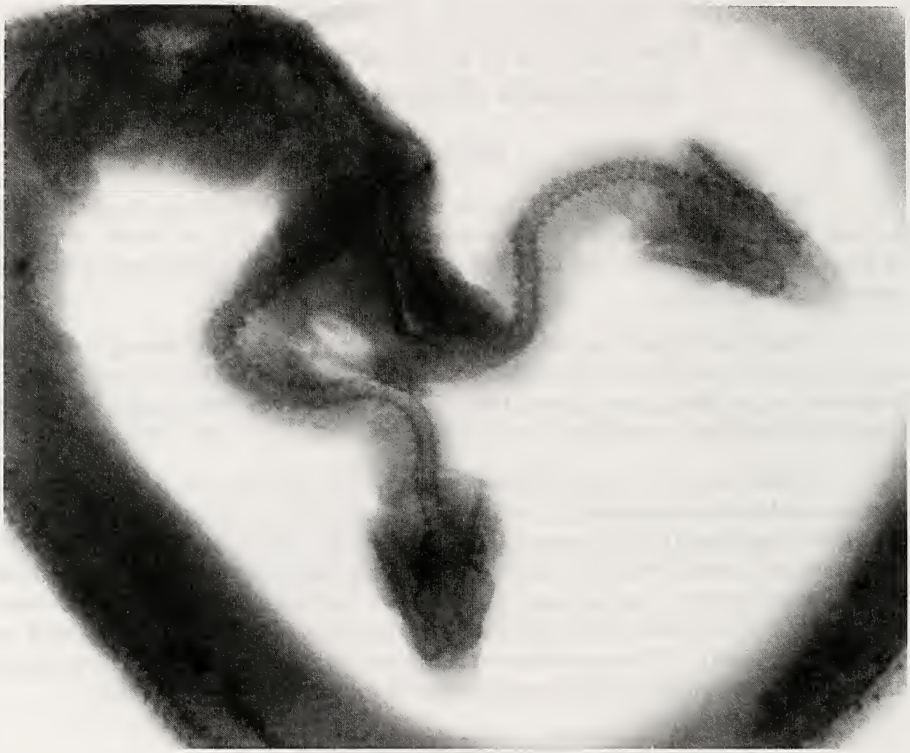

Figure 1.

surface of necks mottled in white and gray, venter of trunk uniformly gray, subcaudals maroon.

The specimen is prodichotomous with a moderately long pair of necks. Length of left and right necks are 80 mm each, representing 21.9% SVL and 19.6% LOA. Left neck with 48 vertebrae and right neck with 44 vertebrae (Fig. 2), fusion zone with 15 vertebrae, total trunk vertebrae 212, and total vertebrae in body and tail 254. Maximum bifurcation of vertebrae is 22.6% trunk and 18.9% total vertebrae; minimum bifurcation of vertebrae is 20.7% of trunk and 17.3% total vertebrae.

Discussion.

In the following discussion one must take into consideration the fact that the dicephalic specimen is not normal and its condition may have affected the scale counts. The number of mid-body scale rows (84 vs. 65-87) and irregular outlines of the dorsal blotches coincide with those of *Boa constrictor occidentalis*, the subcaudal count (42 vs. 45) and number of body blotches (21 vs. 22-30) are low but close to those reported for *B. c. occidentalis*, but the ventral count (225 vs. 242-251) and ventral coloration (gray vs. black) do not fit the description of *B. c. occidentalis*. The ranges for these characters for the species *Boa constrictor* are as follows: midbody scale rows 57-95, ventrals 225-288 (with low value in *B. c. imperator*), subcaudals 43-70 (with low value in *B. c. amarali*), and body blotches 15-35 (with low value in B. c. constrictor). The dicephalic specimen thus falls only within the range of *B. c. imperator* for ventral count (although *B. c. amarali* has as

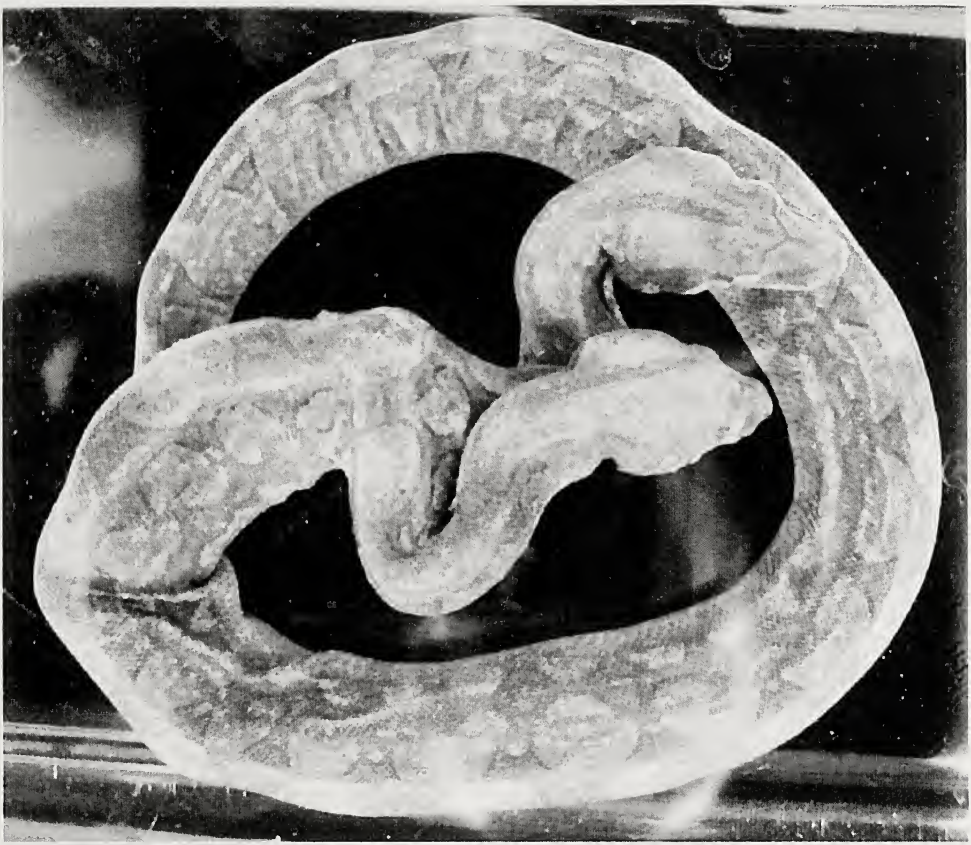

Figure 2.

few as 226 ventrals), is nearest the range of *B. c. amarali* (43) in subcaudal count, and falls within the ranges of *B. c. constrictor* (15-21) and *B. c. melanogaster* (20-21) for dorsal body blotches (Langhammer, 1983). Ignoring the fact that the specimen is aberrant, either there is greater variation than previously known in *B. c. occidentalis* or else the subspecies concept, as in the majority of cases, is taxonomically meaningless. The basal unit in biology is the species and most subspecies reflect only regional color variations.

Of the eight cases of dicephalic *Boa constrictor* for which specimens or photographs are available, four cases are craniodichotomous (Frye, 1981; Gaupp, 1990; Stöckl and Stöckl, 1996; Wallach, unpubl.) and four cases are prodichotomous with relatively long necks (Cunha, 1968; Anonymous, 1974, 2003; present specimen). The only other case in which morphological data are available is that of Cunha (1968), whose specimen had an LOA of 380 mm, neck lengths of 110/112 mm, and 54/58 neck vertebrae (but total vertebral count unfortunately not provided). The necks represented 28.9/29.5% LOA, which is considerably longer that in the present specimen (21.9/19.6 %).

Acknowledgments.

I thank Philip Black and Marc Seymour for the donation of the specimen and Jim Hanken and Jose Rosado of the MCZ for permission to use the X-ray equipment.

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Status of the Rainbow Snake, *Farancia erytrogramma* in Southern Maryland

Abstract.

Five rainbow snake (*Farancia erytrogramma*) records dating from 2005 and 2008 are reported from western Charles County, Maryland approximately mid-way between the historical Maryland records from the Stump Neck peninsula and Newburg. All snakes were captured alive on the road between the hours of 20:30 and 23:00. Sex was determined by ventral and subcaudal scale counts. Four specimens were female, one of which appeared to be gravid with approximately 12 eggs. The remaining specimen was a male. The smallest was a sub-adult female measuring 570 mm total length; the largest an adult female measuring 960 mm total length. Conditions at the times of capture and habitat type are also reported. Speculation is made concerning the northern distribution of the rainbow snake and its ultimate northern limits in Maryland and Virginia.

Introduction.

The rainbow snake, *Farancia ertrogramma* is a semi-aquatic snake inhabiting the south-eastern coastal plain of the United States and feeding primarily on the American eel *Anguilla rostrata* (Neill, 1964). The northern limit of its range is generally considered to be Charles County, Maryland (McCauley, 1945; Harris, 1975); however until the present publication, the total of Maryland records reported in the literature numbered only six (McCauley, 1939; Cooper, 1960; Miller and Zyla, 1992). Three of these records involved snakes killed by the Civilian Conservation Corps in 1937 on the Stump Neck peninsula just south of Indian Head (McCauley, 1939). None of these specimens was preserved, nor were any photos taken. The fourth record dates from 1960 and, as reported by Cooper (1960), involved an adult female found DOR (dead on road) in the vicinity of Newburg and later preserved (NHSM 3012). This locality is also in Charles County, but some 30 km southeast of the Stump Neck records. A fifth record (Miller and Zyla, 1992) involved a juvenile believed to have been taken in 1961 in the same Newburg location by the collector of the 1960 specimen. The specimen (TSU 1966) remained preserved in private hands until 1982 and was not reported in the literature until 1992. The sixth record (TSU 6509) pertains to an adult female taken in 1988 less than 2 km west of the other Newburg records (Miller and Zyla, 1992). It was retained in private hands until 1990. All of these reports are from Charles County and none have been reported from farther south in St. Mary's County. There is one additional Maryland record known to the authors, but not reported in the literature. In 1987 Richard Wiegand, Central Region Biologist, Maryland Department of Natural Resources (DNR) found the multilated body of an adult rainbow snake on the shore of the Potomac south of Cropley in Montgomery County, less than 4 kilometers south of Great Falls (pers. comm.) The tail including the anus of the snake was missing. The remainder was not preserved, nor were any photos taken. This record is some 50 km north of the Stump Neck records, and the only record north of Charles County.

Although there is no reason to doubt any of the records mentioned above, the paucity of specimens with only one reported in the literature between 1961 and 2005 left some doubt as to the snake's continued presence in Maryland. Indeed a study by Forrester and Miller (1992) failed to turn up any rainbow snakes at the Stump Neck site. Personal efforts over many years by Herbert Harris Jr. (pers. comm.), Curator, Department of Herpetology, Natural History Society of Maryland, including the driving of roads and walking of many freshwater streams in Charles County also failed to turn up any specimens. Prior to 1992, the northernmost Virginia specimens were from the Pamunkey River drainage in King William County, some 90 km south of the Newburg, Maryland records (Mitchell and Reay, 1999). In 1992 the first author found a DOR specimen along Dragon

Swamp 4.5 km SSE of Dragonville in King and Queen County almost on the border of Middlesex County in the Piankatank River drainage. In 1993 a specimen was found DOR in northeastern Caroline County in the Rappahannock River drainage (Roble and Hobson, 1994), some 35 km from the Newburg, Maryland specimen. This specimen has been followed by others in that general area from the Mattaponi (Mitchell and Roble, 1998) and Rappahannock (Ferrall, 1999) drainages; however, no specimens have been reported from both the Northern Neck of Virginia nor any part of the Virginia portion of the Potomac River drainage (Mitchell and Reay, 1999). The most recent specimen reported in the Virgina literature (Mitchell, 2005) was from Hanover County further north along the Pamunkey than had been previously reported but well south of the records from Caroline County.

Materials and Methods.

The first author has long been of the opinion that the rainbow snake is a current member of Maryland's herpetofauna. Since finding the DOR in King and Queen County in 1992, he has intermittently searched for the rainbow snake in southern Maryland. As a long-time resident of the state, he was aware of the relatively undeveloped land that exists along the Potomac River in southwestern Charles County between the two historical Charles County localities. In 2005 he decided to localize the search effort to a roughly 7.3 km stretch along Maryland Route 224 from Purse State Park south to Maryland Point Road. The terrain in this area as well as record locations reported in the Results section are shown in Figure 1.

This section of road is perhaps unique in Maryland in that it crosses four different wetlands in six locations in this short length. The wetlands are supplied by small freshwater streams that empty into the Potomac River. The mouths of the streams are partially dammed by the shifting banks of the Potomac. As the topography in the immediate vicinity of the streams is very flat, the streams take on the appearance of marshes in some areas and lagoons with significant vegetation growing in them in other areas. The largest of these wetlands, Thorn Gut Marsh, is 100 to 300 m wide over a distance of roughly two km. Additional upstream damming is caused by beaver activity and by the Route 224 roadbed itself, which is relieved by a single culvert for each stream. These are often partially clogged by branches and other debris. The second author witnessed four beavers working to dam a culvert after it had been freed from debris. This increased the lagoon water level by approximately 70 cm.

Route 224 crosses three of the wetlands in areas where the wetland is on the order of 100 m wide. Figure 2 shows a view to the south along Route 224, where it crosses the wetland located half-way between Wades Bay and Clifton Beach. At this crossing and also at Thorn Gut Marsh, the roadbed is only 1 to 2 m above the water level. The two locations have produced 4 of the authors' 5 rainbow snake finds. At the wetland crossing in Purse State Park (northernmost on the map), the roadbed is at least 5 m above the water level. This location has yet to produce any rainbow snakes, although the habitat is similar to that of Figure 2.

Another significant factor in the decision to localize the search to this particular section of road is that the traffic volume after sunset is estimated by the authors to be on the order of less than one vehicle per hour. Road mortality, particularly of nocturnal species, is relatively low. Before the first rainbow snake was even found, the first author noticed that significant reptile diversity exists in this area. In fact to date the authors have catalogued 15 species of snakes along this section of road (*Agkistrodon contortrix, Carphophis amoenus, Coluber constrictor, Elaphe obsoleta, Farancia ertrogramma, Heterodon platirhinos, Lampropeltis getula, Nerodia sipedon, Opheodrys aestivus, Regina septemvittata, Storeria dekayi, Storeria occipitomaculata, Thamnophis sauritus, Thamnophis sirtalis, Virginia valeriae*).

Fig 1. Study area in Charles County showing record locations reported herein.

As the road provides easy access to habitat presumed suitable to rainbow snakes, it was decided to use "road cruising" as the primary search technique. This technique involves simply driving the road at approximately 40 km/h at night and scanning the road for the target species. During each of the summers of 2005-2008, the authors logged approximately 20 evenings of road

Fig. 2. MD Route 224 looking south at site of captures of 7/26/05 and 8/5/08.

cruising, typically from 20:00 to 23:00. A typical evening included four round trips beginning at Purse State Park and turning around at Maryland Point Road. Driving was not continuous as stops were often made to investigate and photograph reptiles and amphibians other than rainbow snakes. In 2005, observations were simply recorded with hand-written notes. Beginning in 2006, GPS coordinates were taken for all snakes found by the second author. In 2007 eel pots were employed in two locations by the first author in an attempt to capture rainbow snakes. This technique was abandoned after 2007 because the pots could not be checked frequently enough to ensure the safety of captured animals.

Results.

The first of five rainbow snakes was encountered by the first author at 20:57 on July 24, 2005. The snake, an adult female of 960 mm total length, was found immediately after crossing the south branch of Thorne Gut Marsh on the west side of the road (see record 050724 in Figure 1). At the time of capture, the temperature was approximately 28 C, humidity was relatively low, and the wind was calm. Scale counts and measurements are summarized in Table 1. Ventral counts for snakes reported herein were made according to the method of Dowling (1951), in which the count begins at the first belly scale abutting the first dorsal scale row. A photo is provided in Figure 3. The snake was later released at the point of capture on September 9, 2005 as part of an episode in the television series Outdoors Maryland.

On July 26, 2005, two days after the first capture, the first author captured a 710 mm total length female approximately 500 m south of Smith Point Road at 20:35 (see record 050726 in Figure 1). This snake was captured in the middle of the pavement on a slight incline. This location is 300 m north of the nearest wetland. The surrounding habitat consists of deciduous hardwoods

Fig. 3. Female of 7/24/2005; 960 mm total length, 281 g.

Fig. 4. Ventral view, female of 7/26/2005; 710 mm total length, 126 g.

including oak, poplar, beech, and hickory. On this evening the weather was warmer and muggier than July 24 with temperature at the time of capture approximately 30 C. Scale counts and measurements are summarized in Table 1 and a photo is provided in Figure 4. The snake was later released at the point of capture on September 9, 2005. Additional road cruising efforts during the evenings of August 5, 6, 7, 10, 12, 13, and 20 yielded no further rainbow snakes that year.

Beginning in May, 2006 the second author joined the search. A total of 23 evenings of road cruising was logged by the authors with 1 trip in April, 3 in May, 11 in June, 6 in July, 1 in August, and 1 in September. In spite of this effort and in spite of the relatively favorable cumulative rainfall for the summer, no rainbow snakes were seen. The most common snake encountered was the copperhead (*Agkistrodon contortrix*) of which over 21 AOR (alive on road) and 4 DOR were seen in the 23 outings. Copperheads seem to have a preference for the high ground in the study site, particularly the area between Thorn Gut Marsh and the next wetland to the north. The next most common snake was the northern water snake (*Nerodia sipedon*) with 6 AOR and 1 DOR. These snakes were found in the immediate vicinity of the wetlands. The only other notable find of 2006 was an eastern king snake (*Lampropeltis getula*) found AOR at 22:30 at the location shown in Figure 2.

In 2007, the first author continued the road cruising effort and also experimented with the use of eel pots. The summer of 2007 was exceedingly dry. Road cruising produced poor results in general and no rainbow snakes. As an alternate strategy, approximately two dozen eel pots were employed, half at the site of Figure 2, the other half in the southern branch of Thorn Gut Marsh near the road crossing. After some initial difficulties the first author captured northern water snakes in the pots, but no rainbow snakes. The eel pot technique was abandoned for 2008 because the authors were not able to check them on a daily basis.

In 2008 cumulative yearly precipitation was 10 to 25 cm above average through early August. On June 13, 2008 the first author captured an AOR female rainbow snake of 570 mm total length at 21:15 on the west side of the road at the north end of the bridge over the wetland of Figure 2 (see record 080613 in Figure 1). At the time of capture the temperature was 25 C with partly cloudy

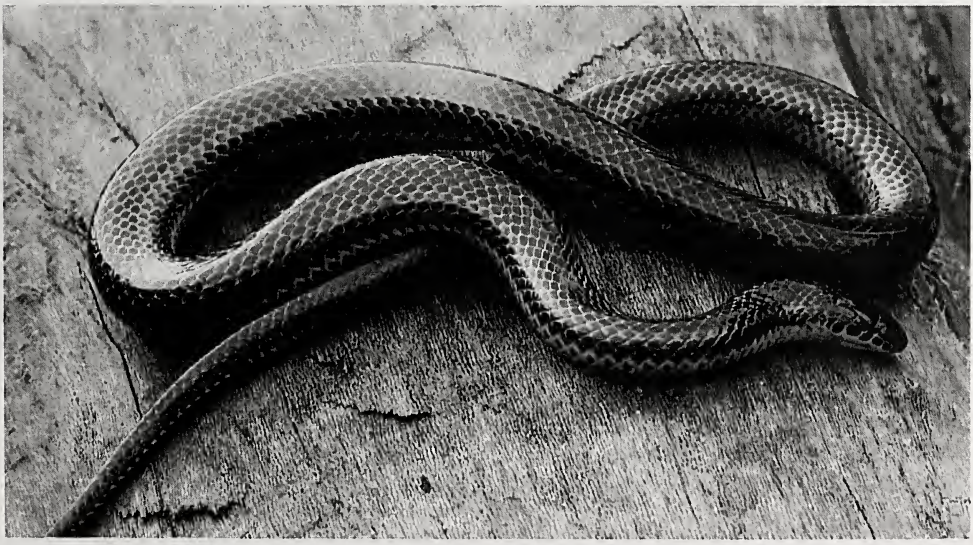

Fig. 5. Dorsal view, female of 6/13/2008; 570 mm total length, 50 g.

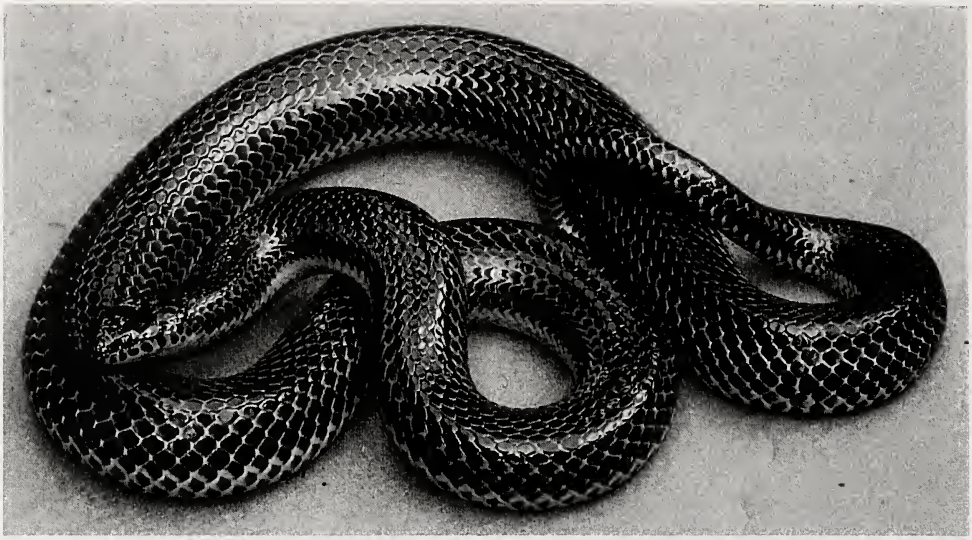

Fig. 6. Dorsal view, female of 6/26/2008; 864mm total length, 324g.

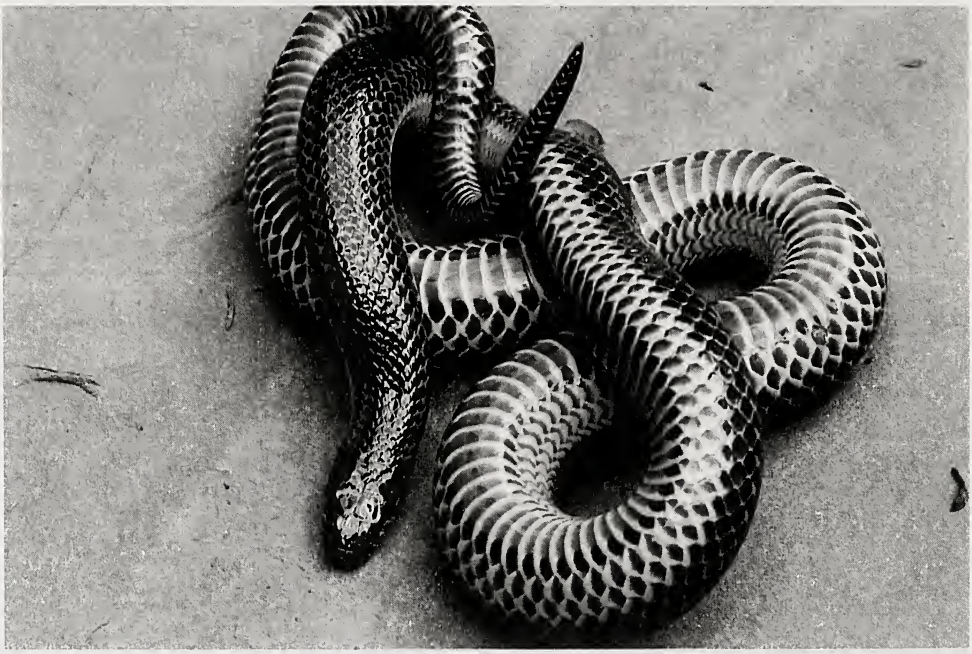

Fig 7. Ventral view of female of 6/26/2008.

conditions. Scale counts and measurements are summarized in Table 1 and a photo is provided in Figure 5. The snake was later released at the point of capture on June 16, 2008.

On June 26, 2008 the second author captured an adult female rainbow snake of 864 mm total length at 22:15 on the grassy eastern shoulder of the road just north of the southern branch of Thorn Gut Marsh (see record 080626 in Figure 1). The snake had its head up in the fashion of

Fig 8. Subcaudals of female of 6/26/08.

a black racer (*Coluber constrictor*) on the prowl and appeared to be just entering the road. At the time of capture the temperature was 24.5 C. Conditions were cloudy with the pavement dry but with storm activity to the south including distant lightning. The snake was slow to flee, but did attempt flight upon very close approach. This is somewhat contrary to the description of Richmond (1945), who indicated that rainbow snakes ignored his presence almost completely. Scale counts and measurements are summarized in Table 1. Dorsal and ventral photos are provided in Figures 6 and 7 and the subcaudals are shown in Figure 8. It can be seen that the 4th subcaudal as well as the 11th through 18th were undivided in this specimen. While the scale counts indicated conclusively that it was female, the snake also gave the appearance of being gravid. The second author estimated the number of eggs to be 12 via palpitation along the belly. The snake was later released at the point of capture on June 29, 2008. An AOR queen snake *(Regina septemvittata)* was found at 22:00 that evening at the location of Figure 2.

On August 5, 2008 the second author captured an AOR male rainbow snake of 711 mm total length on the west side of the road at the south end of the bridge over the wetland of Figure 2 (see record 080805 in Figure 1). This is believed to be the first male rainbow confirmed in the state of Maryland. At the time of capture (22:57) the temperature was 24 C. Conditions were dry, but cloudy and humid, with an air temperature of 25 C at 20:45 dropping to 23 C by midnight. Scale counts and measurements are summarized in Table 1. A dorsal photo is provided in Figure 9 and subcaudals, of which 45 were counted, are shown in Figure 10. In the case of this specimen, the horny end scale may have been damaged as a comparison with the tail shown in Figure 8 would seem to suggest. This scale is not included in the subcaudal count and it does not appear that any additional subcaudals were lost. The only undivided subcaudal was the 23rd. A detail of the ventral region near the head is shown in Figure 11. In keeping with the ventral counting method of Dowling (1951), the first ventral is the scale with double dots immediately below the scale with a red blotch and a single dot on the left. The snake was later released at the point of capture on August 13, 2008.

Discussion.

It is clear from the records presented here that the rainbow snake is a current member of Maryland's herpetofauna. In fact it is possible that the snake may be locally common in small pockets of suitable habitat such as Thorn Gut Marsh. That said, the number of localities in which the

ID	Date	Sex	Mass (g)	Length Total (mm)	Length Tail (mm)	Tail %	Ventrals	Caudals
3707-1	7/XX/37	F	N/A	995*	175*	N/A	162*	36
3707-2	7/XX/37	F	N/A	N/A	N/A	N/A	N/A	N/A
3707-3	7/XX/37	F	N/A	N/A	N/A	N/A	N/A	N/A
600710	7/10/60	F	N/A	930	123	13.2	174	37
6107XX	7/XX/61	juv.	N/A	ca. 220	N/A	N/A	N/A	N/A
870727	7/27/87	N/A	N/A	910**	N/A	N/A	N/A	N/A
880501	5/1/88	F	N/A	1150	150	13.0	167	38
050724	7/24/05	F	281	960	130	13.5	N/A	N/A
050726	7/26/05	F	126	710	90	12.7	N/A	37
080613	6/13/08	F	50	570	75	13.2	N/A	37
080626	6/26/08	F	324	864	127	14.7	171	41
080805	8/5/08	M	185	711	121	17.0	156	45

*measurements and count based on headless tanned hide
**approximate measurement

Table 1. Summary of all Maryland rainbow snake records through August, 2008.

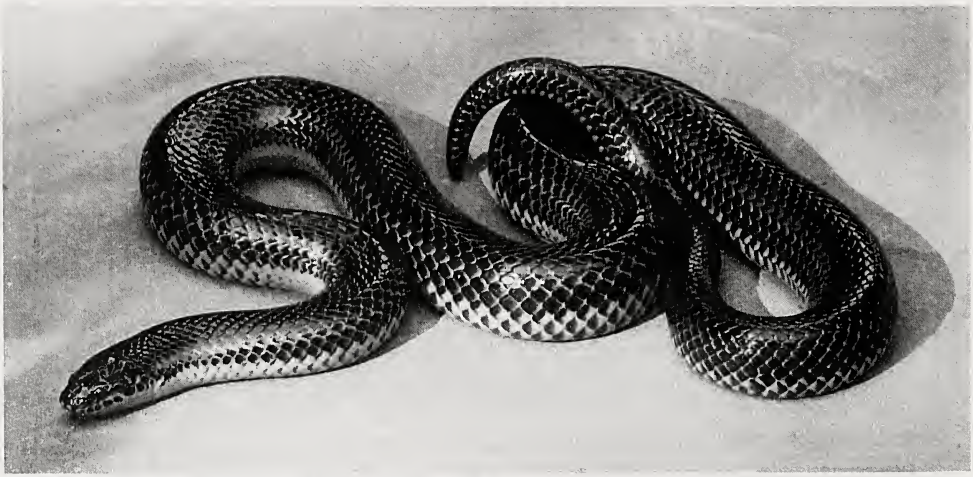

Fig 9. Dorsal view, male of 8/5/08; 711mm, 185g.

Fig 10. Subcaudals of male of 8/5/08.

Fig 11. Ventral details of male of 8/5/08.

snake is present is likely to be few in number. Given the recent finds in both Maryland and Virginia, it is interesting to speculate on the overall distribution in this northernmost portion of the snake's range. Figure 12 shows the northernmost Virginia locations in relation to the known Maryland localities. While the occurrence of marshy creeks emptying into the Potomac in St. Mary's county in Maryland and the Northern Neck counties of Virginia is less common than in Charles County, Maryland, the authors are of the opinion that the existence of the rainbow snake will eventually be confirmed in these areas as well.

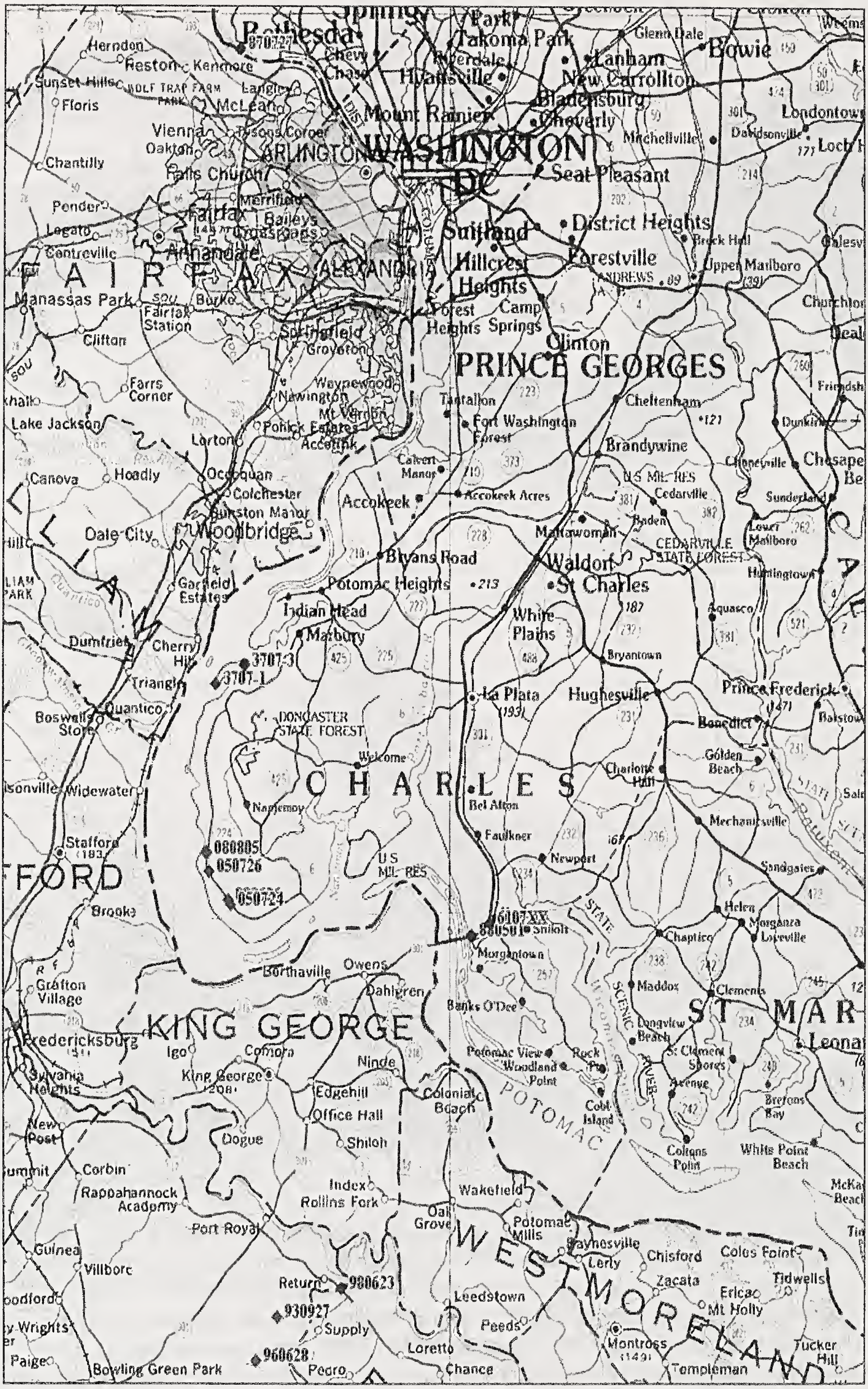

Fig 12. Regional Maryland and Virginia records for *Farancia erytrogamma.*

As for the northernmost location of the rainbow snake, on the Maryland side of the Potomac there is no reason to believe that it does not continue to exist in Chicamuxen Creek on Stump Neck Peninsula in spite of lack of additional finds since the original records from 1937. In fact the lack of recent records is not surprising since Chicamuxen Creek is bordered on one side by a restricted access military facility and bordered on the other by a Wildlife Management Area that can only be accessed by foot. Forrester and Miller (1992) have made the only significant effort to locate rainbow snakes on Stump Neck, and even their effort was greatly limited in time and materials. In any case, the authors believe the range of the rainbow snake is almost certain to extend to Mattawoman Creek south of Indian Head, Maryland and perhaps as far north as Piscataway Creek in southern Prince Georges County, Maryland. There would even appear to be a limited amount of suitable habitat as far north as Roosevelt Island in the District of Columbia. On the Virginia side of the Potomac, the authors would expect finds to be made in Chotank Creek in King George County as well as Potomac Creek and Accokeek Creek in Stafford County. Quantico Creek and Powells Creek are possible sites in Prince William County. The northernmost possible localities would seem to be at Mason Neck National Wildlife Refuge or Accotink Bay at Ft. Belvoir, both in Fairfax County.

The record from Wiegand (pers. comm.) south of Cropley (see Record 870727 in Figure 12) on the northern bank of the Potomac River is problematic, seeming to indicate that the rainbow snake is present in the Potomac River drainage all the way to the fall line. There can be no question about the identification of this snake, as Mr. Wiegand has encountered them on numerous occasions throughout the southeastern United States, but the circumstances of its appearance in this location are unclear. Mr. Wiegand indicated that the tail of the body, including the anus, was missing completely and the remnants had three or four deep wounds obliquely angled across the body, similar to knife wounds, but also possibly inflicted by a bird of prey. At the time he presumed that the snake had been killed earlier that morning by two fishermen he saw along the shore, but he did not confirm this scenario with them. The question thus remains as to whether the snake originated from this location and was killed by the fishermen or whether it was perhaps deposited there by a bird of prey. The general habitat is one of deciduous forest along rocky cliffs without marshland. However, in the immediate vicinity of the find there are several large expanses of sand along an offshoot of the river with very calm water. It does not seem unreasonable that a rainbow snake could travel to this part of the river. In addition, the Maryland DNR's Maryland Biological Stream Survey has documented the presence of the American eel in the Potomac drainage well upriver from Montgomery County, so prey is certainly available for the rainbow snake in Potomac Gorge despite the downstream barrier of Little Falls dam. Thus in summary it is conceivable that rainbow snakes are present in the Potomac Gorge area, but until further records are produced from this area, Mr. Wiegand's record will remain a quandary. If any future observations are reported north of Stump Neck, Maryland in the future, then the Potomac Gorge should certainly receive further scrutiny.

In this spirit we mention a rainbow snake observation made by Mr. Kevin Sullivan (pers. comm.) 300 m west of the intersection of Seneca Creek and Riffle Ford Road (approximately 2.3 km northwest of Quince Orchard) from late spring of 2002. This location is 9 km inland from the Potomac in an area that has been greatly developed since the date of observation. Since there is no physical evidence supporting the observation, and since Mr. Sullivan described himself as having only a basic knowledge of snakes, this observation is not considered by the authors to constitute a record, but is mentioned for the sake of completeness.

What is lacking for more definitive conclusions on the northern distribution is any information on the life history of the rainbow snake at its northern limits in terms of denning and nesting behavior. Richmond (1945) indicated that near Lanexa, Virginia, rainbow snakes lay eggs and overwinter in sandy soil near their aquatic habitats. A similar conclusion was made by Gibbons et al. (1977) in South Carolina. The snakes found at Stump Neck in 1937 were dug from either sandy

soil or tree stumps. While tree stumps are plentiful in the habitat of the current study, sandy soil is generally only available on the edge of the Potomac River. In any case, further information on the life history of the rainbow snake in Charles County would allow for a better estimation of where the northernmost population might be located. It would also better define their habitat requirements for long term preservation.

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Note on Box Turtles (*Terrapene c. carolina*) Aestivating Along a Marshy Stream Bank

The Eastern box turtle (*Terrapene c. carolina*) is commonly thought of as an upland turtle. However, on 25 July 2006 while conducting a rare plant search in Washington County, Maryland, a co-worker (Sharon Madden) and I discovered five adult male box turtles apparently aestivating along the muddy shoreline of Sideling Hill Creek. All five turtles were located within an approximately 30 foot area at the edge of the creek. Two were adjacent to one another; the others were isolated. Two were almost entirely buried with about a 2-inch wide area of their carapace exposed. The other turtles had most of their carapaces exposed but their heads were hidden. They appeared inactive until they were examined to determine their sex. They were then returned to their original locations.

This observation was more than coincidence. There were very few places along this reach of stream that had muddy or marshy substrate, this being the widest observed. It was only about 40 feet long and located between rocky shoreline upstream and downstream. The turtles had obviously gravitated to this area for some reason. Aestivation seems to be the most logical explanation given the time of the year and since they didn't appear to be actively feeding.

I should note that I observed box turtles in the general area on three earlier trips that year, mostly on Sideling Hill Creek floodplain. I found more than twice the number of wood turtles (*Glyptemys insculpta*) in the general area, either on the floodplain or on quite higher ground. No wood turtles, however, were found aestivating with the box turtles or elsewhere.

The idea that box turtles aestivate or otherwise cool down in wet areas is reinforced by an observation made by Dave Lee (personal communication, 2008) and a friend during a drought (late spring or early summer) in the mid-1950s. In a leafy, muddy, spring-fed puddle about the size of a big car port in the woods at Goucher College, they extracted an amazing 75 adult box turtles buried in the mud/leaf mixture. Dave suggested that it must have been the entire population in the wood lot, and he assumed they were there to escape the heat and the drought.

Over the years, I have noted box turtles in quite wet areas, either freshwater marshes or in shallow streams in New Jersey, Maryland, and Virginia. I have even found individuals three different times in my small backyard fish pond during the summer. Once in the fall while wading in a farm pond near Urbana, Maryland, I stepped on something that I initially thought was a rock. It ended up being a box turtle in knee deep water! Another time, I observed a box turtle swimming across a man-made sediment pond. I also have found numerous box turtles on floodplains in Maryland during early spring, apparently coming out of hibernation or seeking the abundant earth worms and other macroinvertebrates that typically occur there. I should point out, however, that radio tracking studies at the Jug Bay Wetland Sanctuary in Anne Arundel County, Maryland have documented box turtle use of floodplains and even fresh tidal wetlands at times. However, overwintering sites there were almost always found in flat, forested uplands (Swarth & Barnett 2008).

The idea that box turtles make use of such aquatic and wetland sites, of course, has been pointed out in a number of field guides on reptiles and amphibians. Cochrane & Goin (1970), for example, consider box turtles in eastern United States to be essentially woodland animals that seldom enter water. Conant(1975) points out that they are essentially terrestrial, but sometime soak themselves "by the hour (or day) in mud or water." Behler and King (1979) describe their habitat as moist forests, wet meadows, pastures, and floodplains. White and White (2002) state that box turtles are usually found in woodlands, meadows, floodplains, or old fields. However, they also indicate that, although box turtles are primarily terrestrial, they occur in wet areas such as marshes, bogs, and shallow vernal pools and ponds.

The idea that box turtles substantially benefit from aquatic sites was reinforced in my mind again this year. On 23 September 2008 a co-worker (George Dizelos) and I, while conducting rare plant survey along a transmission right-of-way in Prince William County, VA, located two male box turtles in a muddy, water-filled rut on the dirt road along the right-of-way. When initially observed, the first turtle was under the water with only its back sticking out, but its head soon surfaced; the second one was about 50 feet away essentially totally submersed with very little of its muddy shell showing the patterning. It could have easily been mistaken for a clump of mud. Both turtles were quite active. Given the somewhat mild temperatures (only mid-70s) and their active movement, these turtles were not aestivating. Further proof of this is that two other box turtles were found in uplands in a mesic forest and grassy right-of-way, respectively, at two other sites on the same day. Likewise, the turtles probably were not just drinking water either, since the entire rut (compared to other nearby ruts with clear water and no turtles) was quite murky due to the disturbed mud. It appears as thought the turtles were feeding, probably on aquatic invertebrates (e.g., dragonfly larvae) or perhaps tadpoles. I have observed dragonfly larvae in the clear water of road ruts elsewhere and at this site very small frogs were observed jumping into the muddy rut. Earlier in the day, we had seen another box turtle (possibly one of these same adults) in a rut on the same dirt road that was quite muddy, but had no standing water. At the time, I thought it strange that the turtle's head was so muddy. Later, however, after seeing the other two turtles in the muddy water, I realized that the first turtle was probably also probing for aquatic invertebrates.

These observations further support the idea that box turtles frequently make use of shallow, open waters and wetlands for various reasons, such as cooling down, aestivating, eating, and drinking, more so than is commonly thought.

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Longitudinal variation in timing of the testicular cycle of the Mallee dragon, *Ctenophorus fordi* (Squamata: Agamidae) from Australia

Ctenophorus fordi has a wide longitudinal distribution in Australia and occurs through eastern Western Australia to southern South Australia with outlying populations in western Victoria and western New South Wales (Cogger, 2000). Information on female reproduction is in Cogger (1969, 1978) who studied *C. fordi* (as *Amphibolurus fordi*) in central western New South Wales. A report of a *C. fordi* clutch size from South Australia is in Morley and Morley (1984) and clutch sizes from Western Australia are in Pianka (1986). There is also reproductive information on reproduction of *C. fordi* in Ehmann (1992). To my knowledge, the only accounts of its testicular cycle are in Cogger (1969, 1978). The purpose of this report is to provide information on the timing of the testicular cycle of *C. fordi* from a western population in Western Australia and to compare it with the testicular cycle of *C. fordi* from an eastern population in New South Wales (Cogger, 1978).

Methods.

Thirty-seven *C. fordi* males, mean snout-vent length, SVL = 46.9 mm ± 2.5 SD, range = 40-52 mm; deposited in the herpetology collection of the Natural History Museum of Los Angeles County (LACM) was examined (see Appendix). Lizards were collected 8-10 km NE Dunges Table Hill (28°08'S, 123°55'E) by Eric R. Pianka in 1967. Gonads were dehydrated in ethanol, embedded in paraffin, sectioned at 5 μm and stained with Harris hematoxylin followed by eosin counterstain.

Results.

Stages in the testicular cycle of *C. fordi* are in Table 1. Testes in four stages were recorded: (1) Recrudescence is characterized by a proliferation of cells in the germinal epithelium for the next period of sperm production (= spermiogenesis), primary spermatocytes predominate; (2) In late recrudescence, there is increased cellularity; secondary spermatocytes and spermatids predominate; (3) In early spermiogenesis, the process of sperm formation has recently commenced. Small clusters of metamorphosing spermatids and sperm line the lumina of the seminiferous tubules, but their numbers are less than observed later in the cycle; (4) In spermiogenesis, numbers of sperm have increased markedly over those seen in early spermiogenesis. No males were found with regressed testes. In testicular regression, the seminiferous tubules typically contain 1-2 laters of spermatogonia with interspersed Sertoli cells.

Spermiogenesis has commenced in May and is underway in 81% (17/21) of the sample. It also is in progress in 100% (15/15) of males from September and continues into December (Table 1).

Table 1. Monthly stages in the testicular cycle of 37 *Ctenophorus fordi* from Western Australia.

Month	N	Regression	Recrudescence	Late Recrudescence	Early Spermiogenesis	Spermiogenesis
May	20	0	2	1	1	16
September	15	0	0	0	0	15
November	1	0	0	0	0	1
December	1	0	0	0	0	1

Discussion.

The timing of events in the testicular cycle of *C. fordi* from Western Australia differs from those described in the study of *C. fordi* in New South Wales at (32°04'S, 146°12'E) and (33°03'S, 146°12'E) by Cogger (1978). In *C. fordi* from New South Wales, males from May are in recrudescence as evidenced by the presence of primary spermatocytes but no sperm (Cogger, 1978). In marked contrast, the testicular cycle in May *C. fordi* males from Western Australia is advanced in comparson to New South Wales as 81% of males are producing sperm (spermiogenesis). *Ctenophorus fordi* males from both populations are undergoing spermiogenesis in (austral spring-summer) September to December. Regression of the *C. fordi* testis occurs in New South Wales in January (Cogger, 1978). No data were available for January *C. fordi* males from Western Australia, however the presence of males from May with testes in recrudescence, late recrudescence and early spermiogenesis suggests there was a period of regression in late summer or autumn.

The testicular cycle of *C. fordi* is accelerated in Western Australia as spermiogenesis begins earlier (in autumn) as opposed to spring in New South Wales (Cogger, 1978). Rather than being in Type I of Heatwole and Taylor (1987) (spring spermatogenesis and mating, spring ovulation) *C. fordi* might better belong in Type III (autumn to spring spermatogenesis, spring mating and ovulation).

Information on comparisons of conspecific testicular cycles at different longitudes is scarce. The testicular cycles of the North American phrynosomatid lizard, *Sceloporus undulatus* was reported on by Altland (1941) who studied a North Carolina population (35°59N, 78°54'W) and Marion (1969) who studied an eastern Missouri population (37°21N, 93°26'W). The testicular cycles appeared to be in synchrony as recrudescence had progressed so early spermiogenesis was underway in both *S. undulatus* populations in November. Spermiogenesis continued in both populations during spring and regression occurred in July (Altland, 1941, Marion, 1969).

Clearly, subsequent investigations are needed to ascertain the amount of longitudinal variation in lizard testicular cycles, and in particular, the significance of the difference in timing of the cycles of *C. fordi* in Western Australia versus New South Wales.

Acknnowledgments.

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Appendix.

Ctenophorus fordi examined from Western Australia housed at the herpetology collection of the Natural History Museum of Los Angeles County (LACM).

LACM 59229, 59241, 59246, 59251, 59254, 59257, 59260, 59262, 59263, 59265, 59269, 59271, 59274-59276, 59279, 59281, 59284, 59285, 59288, 59289, 59292, 59293, 59295, 59297, 59298, 59300, 59304, 59307, 59308, 59312, 59313, 59315, 59316, 59321, 59322, 59331.

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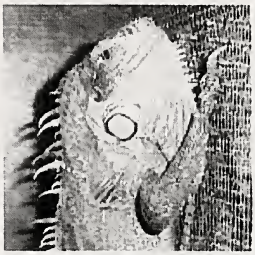

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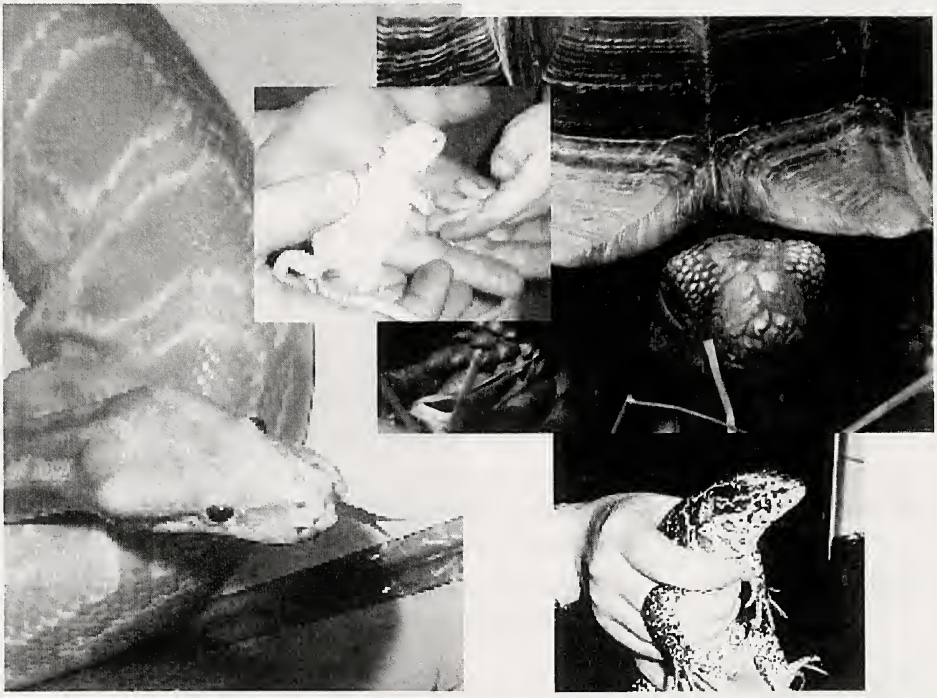

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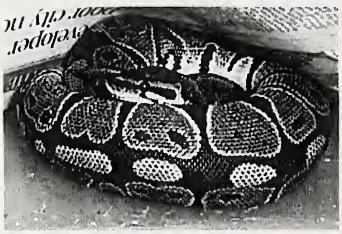

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